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Design of Relays

Introduction

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The electromechanical relay is the basic building block of modern dial switching systems and also of various automatic control systems and computers.

All of these systems depend on the action of the relay which is simple in its functions, but has to meet complex requirements placed on it by the systems in which it is used. Perhaps the best illustration of this apparent conflict is to note that a relay has simply to close or open electrical contacts when its coil is energized or deenergized. However, these simple functions must be performed equally well by millions of relays, and each of these must continue to perform reliably for millions and in some cases for more than a billion operations during its lifetime. Furthermore, in many cases the relay must function in a few thousandths of a second, or use little electrical power. The reliability required in telephone switching systems would be considered unreasonable in many other types of equipment and can be judged from the fact that a single failure in 5,000,000 operations is considered to be poor performance.

Stated another way, satisfactory operation for the average relay in modern telephone switching systems is less than one failure in forty years of operation. The measurement of such low trouble rates is, in itself, a difficult and challenging problem.

The need for such a high degree of reliability and for the associated requirement of high speed is evident from a few figures relating to

modern cross-bar switching systems. In these, establishing a single telephone connection between two subscribers makes use, for a very short time interval, of approximately 1,000 relay operations with a total of about 7,000 contacts.

As the telephone plant has become more mechanized with its local and toll dial systems, automatic message accounting, automatic trouble recorders, etc., the relays have been required to do more things with less trouble. Accordingly, the steady progress which has been made in the automatism of switching equipment has depended upon improving the performance of relays. To provide this improvement, relay design must be guided by a clear understanding of the physical relations among all aspects of performance and the construction specified by the design.

Some of the recent work in the area of relay design, production, service and measurements is covered by this issue which is devoted entirely to the analysis and measurement of relay performance, and to the economic considerations which govern optimum relay design. It is evident from the typical statistics given, that the successful and economical operation of switching systems and certain other existing automatic control systems demand the best in relay performance.

A. C. KELLER